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ABSTRACT

This paper describes the experience and the problems solved in the process of developing and integrating advanced World Wide Web-based services into the University of Patras (Greece) system. In addition to basic network services (e.g., e-mail, file transfer protocol), the final system will integrate the following set of advanced services: a Web-based information service, intranet services to support administrative operations within the campus, distance learning by means of online teletraining via the Web, teleworking facilities, videoconferencing facilities, and applications supporting collaborative work. The paper describes in detail the services provided by the system, system architecture, and the implementation and introduction of the services to users. This project has shown that the development of the services, as well as their integration and introduction to the users, has to follow a well-defined, user-oriented implementation plan. Two figures present the representation of Web servers in the campus network and the intranet architecture. Contains 19 references. (AEF)

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Development and Integration of WWW-based Services in an Existing University Environment

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Abstract: This paper presents the experience and the problems solved by our implementation group, in the process of developing and integrating advanced WWW-based services in the environment of a moderately sized University of Greece, namely University of Patras, which by now offers only basic network services (e-mail, ftp). In the following we present a short overview of the services developed, the overall system architecture, and the critical aspects of introducing the new services to the users.

1. Introduction

The introduction of advanced network services into a university environment is today a basic need, the satisfaction of which enables the leverage of the campus administrative operations, the collaboration between different scientific groups within the university providing new means of communication and introduces the use of new teaching methodologies via the network [December and Randall, 1996]. However, it is not an easy task since it has to overcome the traditional ways of administration, information sharing, and teaching. Moreover, it needs an effective user-oriented implementation and support mechanism in order to assure its widest acceptance and use by the academic community [Reinhold 1996]. At the time being, the University of Patras only supports basic network services such as e-mail and ftp and a few WWW servers developed within some of the University's departments, that partially support the whole campus needs, whereas services like on-line and off-line tele-training and videoconferencing only exist in an experimental level in some of the laboratories.

The basic aim of our project is to provide a set of advanced network services in the campus of Patras. The key point in this effort is to provide the whole set of services under a uniform platform, that is to integrate the services into a system using WWW technology. Beyond the basic services (e-mail, ftp etc.) that are going to be implemented within this project the final system will integrate the following set of advanced services:

- A WWW-based information service.
- Intranet services to support the administrative operations within the campus.
- Distance learning by means of on-line and on-line tele-traing via the Web.
- Teleworking facilities.
- Videoconferencing facilities.
- Applications supporting collaborative work.

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The whole system will be realized through the use of the University network which will be based on the TCP/IP protocol technologies enhanced by the 100Mbit speed, obtained by the fiber optic lines (FDDI) used to connect the University backbone. Two ATM switches will be exploited to connect the high demand real-time applications such as video conferencing.

2. Services Provided by the System

The exploitation of WWW technologies will be the base upon which the final system will be developed. The central web server of the University will provide a wide range of services such as:

- Information about the institution as well as general information such as announcements, festivals and other social activities in the form of multimedia rich documents.
- Links to all other departmental web servers in order to reflect the current status of all the departments.
- A powerful search engine aiming to provide an easy-to-use interface for locating information based on keywords.
- Collaboration tools (such as customized USENET News or bulletin board Software) for information sharing
- Mail services with multimedia capabilities (voice mail)
- A uniform and sophisticated way of updating or inserting information, in order to give all users (professors, post-graduate or under-graduate students) the potential of information publishing

The whole system will be developed based on third party public domain or freeware software (APACHE web server, Harvest and HtDig etc.). By using the latest programming techniques such as JAVA, JavaScript, ActiveX, VRML and WYSIWYG HTML editing, an interactive interface will be built which will enable the use of multimedia in all laboratories of the University [Stone 1994] [Chee 1996].

Another service that is going to be developed within the project life-cycle will be the implementation of several Intranets within the campus, aiming at the reduction of paper use in the administrative procedures in the University. All the traditional paper-only distributed sheets or books will be stored electronically. Using text search and efficient retrieval techniques all documents will be delivered on-demand to named groups of authorized persons without any bureaucracy [Bernard 1996].

A significant aspect that arises in this case is the protection by intruders from outside the University network or from unauthorized users. The encryption provided by the SSL 3.0 protocol will be exploited to transmit information securely. Flexible user authentication controls, read/write access to individual files or directories using user name and password, domain name, host name, client-side certifications or named groups will be exploited.

Videoconferencing & Tele-training will be included in the set of the advanced services provided by the final system. These services enable real-time conferencing interactions over the Internet and Intranet. Conference sessions will allow the University to increase the effectiveness of workgroup, departmental, and cross-functional communication by letting users interact on the same documents, sketching on collaborative whiteboard, exchanging data files, and talking in real time with colleagues in or outside the University [Bouras 1996a].

Customized software will be constructed to enable all university users to participate in Videoconferencing (on-line, off-line) sessions [Basiroglou 1991]. Off-line Videoconferencing will include pre-recorded material such as a tutorial of classroom course. The course will be embellished with pictures and/or video files to give the attendees the closest possible impression conveyed inside the classroom the actual course was given. On-line conferencing refers to the real-time transmission of audio and motion images to multiple recipients. IP Multicasting technology, in conjunction with the latest H.323 and RTP standards, will be exploited to provide timely crucial data [Bouras 1995] [Bouras 1996b].

A Realaudio server will be installed to host all the voice announcements, extracts of important conference speeches and music or other voice material. This server will provide easy voice information access to not only low-speed dial up users but to all other directly connected nodes. The compression and streaming will save precious bandwidth for other applications.

Finally, remote users will be able to access the University network facilities by remote access services. Two kinds of remote access have been defined. The first kind is using the conventional digital phone lines media of communication (33.6KB or 57.6KB modems). Users of this kind will be satisfied at reading multimedia mails, net-surfing the world-wide web sites, Internet chatting, accessing bulletin boards or transferring files. The second, is using ISDN. ISDN access will be supplied to users, who need high speed access to multimedia services with real-time response such as on-line Videoconferencing services.

3. System Architecture

The WWW services will use the Client - Server model so as to take advantage of its ability to distribute data and processing chores across the campus network. The main parts of the application and services run on centralized servers, and any user may have control using special client software designed for this purpose [Nicolaou 1990]. Thus, a number of servers have to be implemented for the provision of the vast volume of information for every department of the University of Patras. Storing and distributing this information using only one server, is not a good solution for a number of reasons:

- the ever growing volume of information originating from the large number of departments of the university, will certainly pose storage problems
- the expected large number of visitors in the web pages of the university server is expected to slow down considerably its network performance
- possible malfunction of the central server will result in the total suspension of every WWW service

Having in mind the above parameters the physical architecture of [fig. 1] has been chosen for the implementation of the services. A central server will store general information concerning the University (historic, geographic information) and links to other servers, which operate in every department of the campus. Similarly, the servers of each department will contain information for the department and links to laboratory WWW servers. Each laboratory will use a separate server for the publication of its research achievements, along with various technical and educational information.

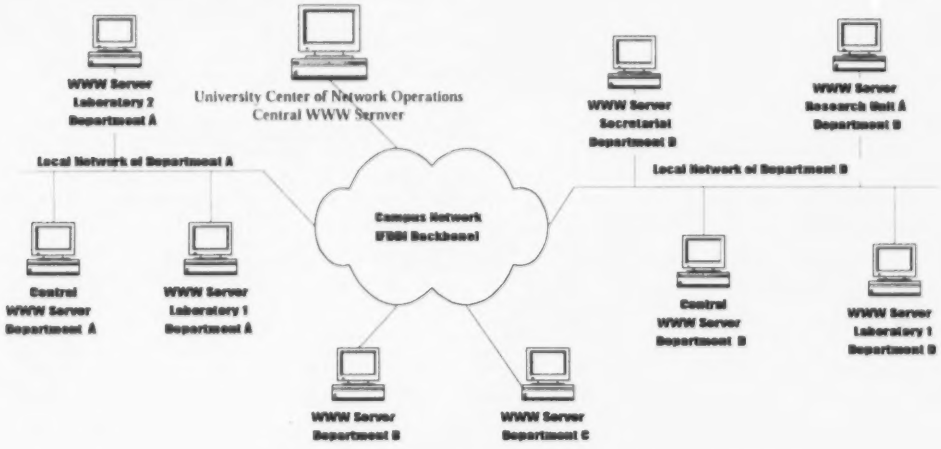

Figure1: Representation of WWW Servers in campus network

The Client - Server architecture is distributed and results in flexible network structures. A main advantage is the capability offered to each laboratory or research team to control all the needed information independently and in a very efficient way. Each department or laboratory will have total control of the provided services causing the traffic load of the campus network to be equally distributed, increasing thus the total network performance.

It should be noted that a laboratory server is not a dedicated WWW machine. Due to the relevant low traffic expected for each laboratory server, standard computer equipment will be used for this purpose. Another alternative is the virtual host implementation, where multiple laboratory servers will be hosted in a single machine. Department servers may also be temporarily hosted in the central university server. The client server architecture does not require special infrastructure or investment by any department or laboratory for its implementation.

The WWW clients are installed in workstations (personal computers or Unix machines) and every user can access both local and remote WWW servers (of other departments or universities).

The implementation of the WWW services requires the use of special transport and control protocols for the handling of information. TCP/IP will be used as the standard communication protocol between the clients and the servers along the network. Initially, the services will be developed and tested in a laboratory LAN. The open architecture used in both the communication protocol and the services ensures the proper operation in the

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university's WAN, which is using FDDI, ISDN and ATM technology [Wolfinger and Moran 1991] [Shepherd 1992] [Grudin 1996].
Each WWW server uses the HTTP (HyperText Transport Protocol) for the transfer of data (text, images and sound) to/from the network. The use of HTTP allows the communication between the WWW server and the client (a WWW browser) via a socket connection established by the TCP/IP protocol [Newcomb 1991].
As far as data security is concerned, the use of special transport protocols such as SSL (Secure Sockets Layer) or/and S-HTTP (Secure HTTP) ensures the transfer of confidential information through secure channels. Such a need in the University of Patras rarely arises, but even then other methods such as authentication based on the source network address and passwords meet, to some point, the needs for security [Garzotto 1993].
CGI (Common Gateway Interface) is the most common way of communication between Web applications and Databases, creation of search engines and presentation of web pages. It will be used for the implementation of services, which require a more powerful implementation tool than HTML [Gebhardt 1995].
The mail services will use a variety of protocols including SMTP (Simple Mail Transport Protocol), MIME (Multimedia Interface Mail Extensions) and POP3 (Post Office Protocol). These protocols will be used for the transfer of messages via e-mail or distribution mailing lists. The inclusion of MIME enables the transfer of not only text but of multimedia messages as well [Costa Carmo 1992] [Bulterman and Liere 1991].

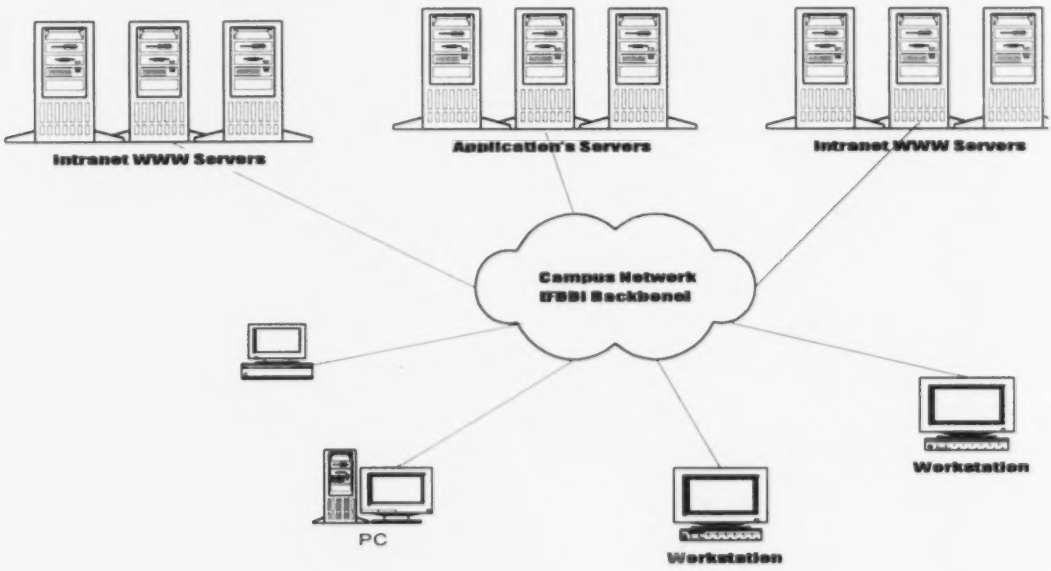

Figure 2: Intranet Architecture

Finally, the Intranet architecture will use the client - server model and the same protocols as well. [Fig. 2] represents the Intranet infrastructure at the University of Patras.

4. Implementation and Introduction of the Services to the Users

One of the most critical stages of the whole project is the introduction of the services to the users. International experience has shown that the gradual and easy introduction of the system to the users as well as its interactivity and functionality are some of the major factors that will determine its acceptance. Moreover, having in mind that the final system will be used for the educational procedures within the campus, several pedagogical aspects must be taken into account.
Based on the above considerations the project team is going to consume a great deal of efforts towards the following directions:

- The administration and support of all network services will be integrated in the University Center of Network Operations.

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- Integration of the whole set of services under a uniform platform using a friendly and easy to use user interface to support the interaction with the users.
- A special team of pedagogues will design the entire human-machine interaction, especially in the case of distance learning.
- A common methodology will be developed for the implementation of similar services in every department of the campus.
- There will be on-line help available, as well as a special team that will support the users in the case of any technical or non-technical problems.
- A series of seminars will be held for the introduction of the services to the users

The final purpose is to develop an interactionally rich system to support efficient and effective user functionalities, taking advantage of the new WWW multimedia infrastructures currently available based on a friendly and easy to use user interface.

5. Conclusions

We will develop, at the University of Patras, a set of advanced services to facilitate academic and research activities. Internet applications are worldwide used to support all relevant activities. Web pages developed will include a number of information and search engines will be used to provide access to these pages. Although, Intranets are not widely used in academic environments, but recently a tension has aroused in developing such services (especially in the USA) to support intercommunication between the different departments of the University of Patras. The services to be developed will serve as a guideline for all relevant applications to be developed in the future in Greece

Our work showed once more that the introduction of new network services in an existing environment, even if this is a University, is not mainly a technological problem. The development of the services, their integration and introduction to the users has to follow a well-defined, user oriented implementation plan.

The final output will be a pool of advanced services focused on the user needs for effective information retrieval and spreading, and the use of alternative education tools

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